Study of Medium-induced Parton Energy Loss in γ+jet Events of High-Energy Heavy-Ion Collisions *

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Among the proposed hard probes of dense matter in high-energy heavy-ion collisions, large transverse momentum jets or partons are especially useful because they interact strongly with the medium. Jet quenching due to the medium-induced radiative energy loss of a high-energy parton propagating through a dense medium can provide important information on the properties of the medium and interaction processes that may lead to partial thermalization of the produced parton system.

In QCD, one can measure the radiative energy loss indirectly via the modification of the jet fragmentation function. In order to measure the fragmentation function one has to first determine the initial energy of the fragmenting parton. We propose to measure the particle p_T distribution in the opposite transverse direction of a tagged direct photon. Since a direct photon in the central rapidity region ($y = 0$) is always accompanied by a jet in the opposite transverse direction with roughly equal transverse energy, the p_T distribution of particles in that direction is directly related to the jet fragmentation function with known initial energy, $E_T^{\rm jet} \approx E_T^\gamma$. In such $\gamma + {\rm jet}$ events, one can easily extract the fragmentation function from the experimental data. By comparing the extracted jet fragmentation function in AA to that in pp collisions, one can then measure the modification of the fragmentation function and determine the parton energy loss.

In this paper, we have studied in detail the effect of parton energy loss on the jet fragmentation function as extracted from the p_T spectrum in the opposite direction of a triggered direct photon. In particular, we have taken into account the E_T smearing of the jet due to initial state radiations associated with the $\gamma + {\rm jet}$ processes. We have shown that the particle spectrum from jet fragmentation at $p_T \sim E_T^\gamma$ is very sensitive to the E_T broadening from initial and final state scatterings with beam partons (see Fig. 1). One can then use our proposed measurement to determine the E_T broadening in pA collisions. This small but finite effect must then be subtracted out when one determines the medium-induced parton energy loss in AA collisions.

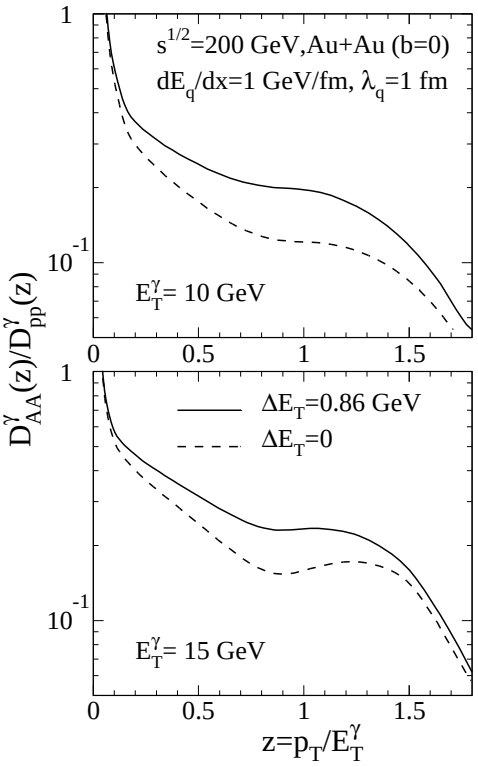

Figure 1: The modification factor for the inclusive fragmentation function of photon-tagged jets with (solid) and without (dashed) E_T broadening due to initial parton scatterings.

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